Factors Associated with Cataract Surgical Outcomes in a Tertiary Health Facility in Oyo State, Nigeria: A Retrospective Study

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Abstract

Background: Cataract surgery is the most common operation performed in ophthalmology. It is the commonest cause of reversible blindness globally, in Sub-Saharan Africa and Nigeria. The study examined some factors affecting the outcome of cataracts surgery measured by Visual acuity after 6 weeks.

Methods: Data was collected from the records of ophthalmic patients who had cataract surgery at LAUTECH Teaching Hospital Ogbomoso, from the period of January 2013 to December 2018. Two hundred and twenty-seven patients’ records were retrieved for the study. Logistic Regression was used to investigate factors associated with the outcome of Cataracts Surgery. The goodness of fit test was used to determine the fit of the model to the data.

Results: Two variables; intraoperative complication, and unaided visual acuity on the first post-operative day were statistically significant (p-value < 0.05). The outcome of surgery using unaided visual acuity after six weeks of surgery showed that 47.1% of the patients had a good visual outcome (6/18) or better and 52.9% had a poor outcome (worse than 6/60). Factors such as complications within six weeks, presence of ocular and systemic comorbidity, and presence of intraoperative complications were found to increase the likelihood of poor outcomes in cataract surgery.

Conclusion: This study has shown that Intraoperative complications and unaided visual acuity on the first postoperative day are important to the outcome of cataract surgery. Therefore, the two factors should be given attention during cataract surgery.

Keywords: Cataract, Surgery, LAUTECH Teaching Hospital, Logistic Regression, visual acuity
1.0 INTRODUCTION

Blindness has been described as a global problem. Some of the socioeconomic impact of blindness are reduction of quality of life, one’s capabilities, usefulness in the family, community, and the nation at large [1]. A cataract is the opacification of the crystalline lens of the eye, which may take a short duration or several years to develop, depending on the cause [2, 3]. Cataract accounts for half of the 37 million blind persons in the world [4]. An unoperated cataract is the most prevalent cause of blindness in the Caribbean [5]. In sub-Saharan Africa and other parts of the globe, cataract is the leading cause of blindness, where it is estimated to account for about half of all cases of blindness [6]. In Nigeria, 42.9% of blindness is caused by cataracts and the prevalence of blindness is 4.2% among individuals aged 40 years or older and 5.5% among individuals 50 years or older [7]. Older age, gender smoking, diabetes, ultraviolet light, dehydration, and antioxidant deficiencies are some of the risk factors associated with cataract formation, the commonest being age-related [8].

It has been approximated that 10 million cataract operations are carried out every year. However, if global cataract blindness is to be eliminated, this figure must increase to 30 million by 2020, and most of that increase must take place in the poorest countries of Africa, Asia, and Latin America [9, 10, 11].

The outcomes of cataract surgery can be measured using an objective clinical indicator such as visual acuity (VA) and/or subjective indicators such as quality of life (QOL) and visual functioning (VF) instruments [12]. The indicator used to estimate the extent to which a population’s cataract surgical needs have been met is called the Cataract surgical coverage (CSC). CSC is the proportion of the people who were eligible for surgery and who received it. However, the CSC in many Sub-Saharan Africa settings remains consistently low. A number of factors hinder higher CSC and this may include health system and patients related factors such as inadequate ratio of surgeons to patients, inadequate equipment and consumables, inefficient referral services; or unwillingness of the patients to access services [13]. There is also evidence indicating barriers associated with gender in accessing cataract surgical services as it has been reported that access is lower among women than men [14].

As the number of surgeries done in a year is being measured by the CSC, measuring the quality of the surgeries provided to the population is also equally important. Post-operative visual acuity is considered an informative indicator of surgical quality. The World Health Organization (WHO) recommends that good post-operative outcomes should be seen in at least 80% of operated eyes and that not more than 5% should have a poor outcome [9]. Population-based studies in Sub-Saharan Africa report 30% of cataract surgical outcomes as good [15]. In Sub-Saharan Africa, poor outcomes outnumber good outcomes by 13% and there is no correlation between cataract surgical rates and their outcomes [13].

A cataract surgical outcome is said to be “good” after six weeks of surgery if post-operative presenting visual acuity is 6/18 or better, while a “poor” outcome is defined as presenting visual acuity worse than 6/60 six weeks after surgery [16]. In sub-Saharan African settings, recent population-based studies report good outcomes in as few as 30%, which do not meet the WHO recommendation [15]. The grading method has been used by some studies to monitor cataract surgical outcomes in different countries [17, 18, 19]. Various factors have been discovered to be responsible as barriers for not seeking modern cataract surgery in Nigeria and some other parts of the world. Some of these factors is the cost of eye surgery [20, 21, 22]. Other factors are ignorance, fear of going through surgery, ability to afford cataract surgery and a far distance from the facilities [23, 24, 25, 26].

2.0 METHODOLOGY

This study is a descriptive cross-sectional study using secondary and primary data. The outcome variables were collected from the study patients who had undergone cataract surgery, unilateral or bilateral, at the Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso. The data span from 2013 to 2018 with a total of 227 patients with complete data in their hospital folders in September, 2019. The sample contains Pre-operative Evaluation results of patients and the result of their surgery. Logistics Regression was used to investigate factors influencing the outcome of Cataracts Surgery.
2.1 Outcome and Explanatory Variables

The following variables were extracted from the files of the patients: demographic variables such as gender and age of patients. Other explanatory variables in this research work are eye operated, category of the surgeon, types of anesthesia administered, intra-op complication(s), complication(s) within 6 weeks, complications after 6 weeks of surgery, unaided visual acuity on the first post-operative day, pre-operative visual acuity, ocular and systemic comorbidity. The outcome variable of interest is visual acuity (unaided) after 6 weeks. This variable is transformed into a dichotomous variable (visual acuity of good or poor outcome).

2.2 Statistical Analysis

Binary logistic regression analysis was conducted to explore the association between the covariates and the dependent variable (surgical outcomes). MS Excel (2013) and IBM SPSS 21 statistical packages were used for data management and analysis.

2.3 Logistic Regression

In order to explore the predictors of poor outcomes among patients, a binary logistic regression was used to model the effect of factors such as age, gender, the occurrence of complication within six weeks of operation, type of anesthesia, ocular comorbidity, systemic comorbidity, category of the surgeon, side of eye operated, intra-operative complication, visual acuity before surgery, complication(s) after 6 weeks of surgery, unaided visual acuity on the first post-operative day on surgical outcomes.

The logistic regression model is defined as:

\[
\ln \left( \frac{p}{1-p} \right) = \beta_0 + \sum_{j=1}^{k} \beta_j X_j \quad \text{............(1)}
\]

Where \( p \) is the probability of poor surgery outcome and \( 1-p \) is the probability of good surgery outcome. \( \beta_0 \) and \( \beta_j \) are the intercept and the regression coefficient of the \( j \)th predictor respectively, \( j = 1,2,\ldots,k \).

Equation (1) can be equivalently expressed as:

\[
p = \frac{\exp \left( \beta_0 + \sum_{j=1}^{k} \beta_j x_j \right)}{1 + \exp \left( \beta_0 + \sum_{j=1}^{k} \beta_j x_j \right)} \quad \text{............(2)}
\]

Since logistic regression calculates the probability of success over the probability of failure. The results of the analysis are in the form of an odds ratio.

\[
OR = \frac{p(1)/[1-p(1)]}{p(0)/[1-p(0)]} \quad \text{............(3)}
\]

The odds ratio measure the effect of effect size, describing the strength of association or non-independence between two binary data values. It is defined as the ratio of odds for \( x=1 \) to the odds for \( x=0 \) and is given by the equation

\[
OR = \frac{p(1)/[1-p(1)]}{p(0)/[1-p(0)]} \quad \text{............(4)}
\]

For logistic regression with a dichotomous independent variable coded 1 and 0, the relationship between the odds ratio and the regression coefficient is given in equation (5). This simple relationship is the fundamental reason why logistic regression has proven to be such a powerful analytic research tool.

\[
OR = e^{\beta_j} \quad \text{............(5)}
\]

To assess the appropriateness and adequacy of the model, the statistical significance of each of the independent variables is assessed by carrying out the Wald chi-square statistic. Equation (6) presents the Wald statistic. This \( z \) value when squared yields a wald statistic with a chi-square distribution.

\[
z = \left( \frac{\hat{\beta}_j}{se(\hat{\beta}_j)} \right) \quad j = 1,2,\ldots,k \quad \text{............(6)}
\]

The overall goodness of fit of the model is assessed using the Hosmer-Lemeshow test, indicating whether the model prediction does not significantly differ from the observed [27]. The Cox and Snell and the Nagelkerke \( R^2 \) are two goodness of fit test similar to the coefficient of determination \( (R^2) \) in linear regression.
3.0 RESULTS

3.1 Descriptive Statistics

From Table 1, the sample of 227 patients consisted of 122 (53.7%) males and 105 (46.3%) females, who had undergone cataract surgery. The age at surgery ranged from 5 to 95 years (mean; 65.56 ± 17.355 years). There were predominantly older age group of patients > 64 years – 147 (64.8%). Few patients were < 45 years – 18 (7.9%), while 62 (27.3%) aged between 45 and 64 years. One hundred and twenty-three (54.2%) left eyes were operated, while one hundred and four (45.8%) right eyes were operated. Ocular Comorbidities were present in fifty-eight (25.6%) and Systemic Comorbidities in 79 (34.8%). Out of the 227 cataract surgery carried out, 207 (91.2%) was performed by trainee surgeon while 20 (8.8%) was carried out by trainee surgeon.

Local Anesthesia was administered to 214 (94.3%) patients while General Anesthesia was administered to 13 (5.7%) patients. Furthermore, 172 (75.8%) patients had post-surgical complications (after six weeks) and twenty-five (11%) had an intra-operative complication(s). Two hundred and twenty (96.8%) patients had visual acuity < 6/60 to light perception (PL), while seven (3.1%) patients had visual acuity < 6/36-6/60. One hundred and ninety-nine (87.7%) had visual acuity worse than 6/18 while twenty-eight patients (12.3%) had visual acuity 6/18 or better. One hundred and twenty patients (52.9%) had visual acuity worse than 6/18 while one hundred and seven (47.1%) had visual acuity 6/18 or better.

3.2 Socio-Demographic Characteristics

The two socio-demographic variables included in the model were sex and age group of patients. It can also be observed from Table 1 that there were more male patients 122 (53.7%), compared to their female counterparts 105 (46.3%) who had undergone cataract surgery. Poor outcome is less likely in female than male (OR = 0.616, 95% CI [0.335 – 0.913]). The age at surgery ranged from 5 to 95 years (mean; 65.56 ± 17.355 years) and was grouped into three. The odd of poor outcome decreased among patients aged 45-65 years (OR = 0.681, 95% CI [0.108 – 4.272]) compared to age group < 45 years, but increased odds were seen in patients aged at least 65 years compared to patients aged < 45 years (OR = 1.764, 95% CI [0.289 – 10.778]).

3.3 Medical and Surgical History

Two of the clinical variables were statistically significant (p-value < 0.05). They were intraoperative complication (OR = 4.358, p-value = 0.014, 95% C.I. [1.340 – 14.172]) and visual acuity unaided first day (OR = 7.409, p-value = 0.003, 95% C.I. [1.936 – 28.348]). Patients who had intraoperative complication(s) were 4.358 times more likely to have poor post-surgery outcomes compared to patients who had no intraoperative complications. Also, patients who had worse than 6/18 unaided visual acuity on the first postoperative day were 7.409 times more likely to have poor post-surgery outcomes compared to patients who had 6/18 or better.

4.0 DISCUSSION

This study investigates the factors influencing the outcome of cataract surgery based on visual acuity six weeks after surgery. The World Health Organization recommends that good post-operative outcomes should be seen in at least 80% of operated eyes and that no more than 5% should have a poor outcome. Findings from this study show that the data set used fall short of the WHO standard (less than 20% per outcome), as the poor outcome as presented in this study is 52.9%. The results obtained from some previous surveys have shown that at least 40% of postoperative eyes have a presenting visual acuity worse than 6/18 [17, 19, 28]. In another study conducted in Trinidad and Tobago, the corresponding percentage of patients with poor outcome was just below 34% [12]. The result of this work is however better when compared with what was reported in Nigeria that 29% of cataract surgeries had good outcomes while 44.1% resulted in poor outcomes [29]. Results from Malawi also showed that 23.3% of cataract surgeries result in good outcomes while 53.3% result in poor outcomes [30]. Socio-demographic characteristics in the data set; sex, and age were not significant factors in this study. While Soron et al., [12] completely agreed with this, some studies have however identified age as significantly associated with poorer visual outcomes [31]. Desai et al., found out that patients whose age are at least 90 years were four times at risk of poor outcomes compared to those aged 50 to 59 years [32]. This study finds out that the likelihood of poor outcomes from female patients is 0.616 times lower (OR = 0.616) compared with male patients. Another survey that corroborates this found postoperative visual acuity in...
Table 1. Analysis of Factors Associated with Cataract Surgical Outcome After Six Weeks

<table>
<thead>
<tr>
<th>Factors</th>
<th>Good outcome</th>
<th>Poor outcome</th>
<th>p-value</th>
<th>Odds ratio</th>
<th>95% Confidence interval for Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**&lt; 45</td>
<td>3 (2.8)</td>
<td>15 (12.5)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>45 – 64</td>
<td>41 (38.3)</td>
<td>21 (17.5)</td>
<td>0.681</td>
<td>0.681</td>
<td>0.108 – 4.272</td>
</tr>
<tr>
<td>65 years and above</td>
<td>63 (58.9)</td>
<td>84 (70)</td>
<td>0.539</td>
<td>1.764</td>
<td>0.289 – 10.778</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Male</td>
<td>48 (44.9)</td>
<td>75 (62.5)</td>
<td>0.118</td>
<td>0.616</td>
<td>0.335 – 1.131</td>
</tr>
<tr>
<td>Female</td>
<td>59 (55.1)</td>
<td>45 (37.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complication within six weeks after surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**No</td>
<td>34 (31.8)</td>
<td>21 (17.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>73 (68.2)</td>
<td>99 (82.5)</td>
<td>0.602</td>
<td>1.216</td>
<td>0.584 – 2.534</td>
</tr>
<tr>
<td>Anesthesia</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>**Local</td>
<td>106 (99.1)</td>
<td>108 (90)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>1 (0.9)</td>
<td>12 (10)</td>
<td>0.118</td>
<td>0.133</td>
<td>0.011 – 1.164</td>
</tr>
<tr>
<td>Ocular comorbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Absent</td>
<td>85 (79.4)</td>
<td>84 (70)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>22 (20.6)</td>
<td>36 (30)</td>
<td>0.339</td>
<td>1.405</td>
<td>0.699 – 2.823</td>
</tr>
<tr>
<td>Systemic comorbidity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Absent</td>
<td>72 (67.3)</td>
<td>76 (63.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present</td>
<td>35 (32.7)</td>
<td>44 (36.7)</td>
<td>0.774</td>
<td>1.099</td>
<td>0.479 – 1.729</td>
</tr>
<tr>
<td>Level of surgeon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Trainee</td>
<td>7 (6.5)</td>
<td>13 (10.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trainer</td>
<td>100 (93.5)</td>
<td>107 (89.2)</td>
<td>0.207</td>
<td>0.494</td>
<td>0.165 – 1.478</td>
</tr>
<tr>
<td>Eye operated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**Right</td>
<td>48 (44.9)</td>
<td>56 (46.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>59 (55.1)</td>
<td>64 (53.3)</td>
<td>0.740</td>
<td>0.900</td>
<td>0.484 – 1.675</td>
</tr>
<tr>
<td>Intraoperative complication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**No</td>
<td>103 (96.3)</td>
<td>99 (82.5)</td>
<td>*0.014</td>
<td>4.358</td>
<td>1.340 – 14.172</td>
</tr>
<tr>
<td>Yes</td>
<td>4 (3.7)</td>
<td>21 (17.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual acuity before surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**&lt;6/36 – 6/60 (Ref)</td>
<td>5 (4.7)</td>
<td>1 (0.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;6/60 – PL</td>
<td>102 (95.3)</td>
<td>119 (99.2)</td>
<td>0.272</td>
<td>4.410</td>
<td>0.312 – 62.250</td>
</tr>
<tr>
<td>Complication after 6 weeks of surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**No</td>
<td>102 (95.3)</td>
<td>104 (86.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5 (4.7)</td>
<td>16 (13.3)</td>
<td>0.059</td>
<td>3.255</td>
<td>0.958 – 11.054</td>
</tr>
<tr>
<td>Visual acuity unaided first day post-operative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>**6/18 or better (Ref)</td>
<td>25 (23.4)</td>
<td>3 (2.5)</td>
<td>*0.003</td>
<td>7.409</td>
<td>1.936 – 28.348</td>
</tr>
<tr>
<td>Worse than 6/18</td>
<td>82 (76.6)</td>
<td>117 (97.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correctly classified cases: 69.6% Omnibus coefficient: 62.356, df = 12, p-value < 0.001

*p-value < 0.05 indicates significance; **Reference variables.

The model was statistically significant as the result of Omnibus goodness of fit was statistically significant; $\chi^2 = 62.356$, df = 12, p-value < 0.001, and the model correctly classified 69.6% of the cases.
males resulting in poor outcomes from cataract surgery 37% (OR =1.37) more than results from the females [12]. However, a survey from Pakistan and India shows that females were linked with poor surgical outcomes compared to males [17, 33].

The occurrence of complications within six weeks increased the likelihood of a poor outcome by 1.216 times (OR = 1.216). Also, poor surgical outcome was less likely in surgery carried out using general anesthesia compared to local anesthesia (OR = 0.133).

This study reveals that the likelihood of poor surgical outcome increased in patients with ocular comorbidity by 1.405 times. This is in agreement with some studies, which asserted that the presence of an ocular comorbidity increases the likelihood of a poor outcome by at least two-fold [12, 31, 32, 34]. Although the category of the surgeon was not significantly associated with poor outcomes in cataract surgery, the likelihood of a poor outcome increased by two-fold (OR = 0.494) when performed by a trainee compared to a trainer.

From this study, the likelihood of poor outcome is 0.9 times lower (OR = 0.900) when surgery is carried out on the left eyes compared to the right eyes. This is however not consistent with the results of a previous study carried out in Trinidad and Tobago where the likelihood of poor outcome increased by 11% (O.R. = 1.11) when surgery is carried out on the left eyes compared to the right eyes [12]. This may probably be due to the surgeon’s handedness.

Intraoperative complication was significantly associated (p-value = 0.014) with the outcome of cataract surgery. The likelihood of a poor outcome increased by 4 times (OR = 4.358) in patients with intraoperative complications. Also, patients with complications after six weeks of surgery were 3 times more likely to have a poor outcome compared to those who did not have complications. Some studies also found that poor visual outcomes were mostly attributed to surgical complications [35, 36]. Also, Lewallen et al., [13] asserted that one of the factors that may affect the likelihood of good outcomes is surgical complications.

For patients with visual acuity <6/60 to PL (light perception) before surgery, the likelihood of a poor outcome increased by 4 times (O.R. = 4.410) when compared with patients with visual acuity of <6/36 – 6/60.

Unaided visual acuity first day post-operative is another statistically significant variable (p-value = 0.003). Patients whose unaided visual acuity first day post-operative is worse than 6/18 are 7 times more likely to have a poor outcome (O.R. = 7.409) compared with patients who have 6/18 or better.

In this study, intraoperative complications and visual acuity unaided first day are identified as statistically significant factors affecting the outcome of cataract surgery after six weeks. One of the factors that play an important role in surgical outcomes is biometry. Many of the patients studied had no pre-operative biometry. Eye surgeons should be trained and retrained for professionalism in handling eye surgery. Adequate human and material resources are important in enhancing CSC and improving outcomes of cataract surgery.

Conflict of Interest

The authors declare that there is no conflict of interest.

Authors Contribution

ATO conceived and designed the study, contributed to data analysis tools, analysed the data set using suitable statistical approach and writing the original draft of the article; STA contributed to study design, data collection and writing the original draft of the article; OO supervised, contributed to data collection, proof read the text, provided input and recommendations for improving the article; KIO analysed the data set using suitable statistical approach and proof read the text and provided input and recommendations for the article improvement

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